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**COMPLEMENTARY AND ANALOGOUS COLORS IN MOBILE ADVERTISING:
THE IMPACT OF COLOR ON ADVERTISEMENT MEMORY AND ATTITUDE
TOWARD THE AD**

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COMPLEMENTARY AND ANALOGOUS COLORS IN MOBILE ADVERTISING: THE IMPACT OF COLOR ON ADVERTISEMENT MEMORY AND ATTITUDE TOWARD THE AD

ABSTRACT

This research analyzes the influence of analogous and complementary colors in mobile advertising effectiveness. Previous research on the effect of color in advertising is often contradictory and does not investigate the influence of different color combinations. Furthermore, previous studies did not control product involvement: these research studies were conducted in low-involvement settings only. Two experimental studies (N-total = 180) revealed that advertisement memory is significantly higher for complementary colored advertising, while the attitude toward the ad is significantly higher for analogous colored advertising. Advertisers may incorporate these findings to choose advertisement color effectively according to each advertisement's specific purpose.

Keywords: Color, Advertising, Memory, Attitude.

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INTRODUCTION

The study of the effect of color in what regards human perception has been performed across the most diverse scientific fields, from physics to psychology, sociology, and marketing (Panigyrakis et al., 2015). Concerning the role of color in marketing, the existing literature is still at its initial stage (Labrecque et al., 2013) being the aim of this research to extend it.

Nowadays, consumers are exposed to thousands of advertisements a day and the average advertisement time length is often short, merely lasting a small number of seconds, if not less. Such exposure hinders the possibility of each individual advertisement to stand out and be remembered by the consumer post-exposure. It is therefore no surprise that advertising memory metrics such as recall and recognition are recurrent in Marketing literature. However, there is merely a handful of studies linking the effects of advertising color on these metrics. Meyers-Levy and Peracchio (1995) observed that, under low-involvement settings, colored ads outperform non-colored ads in terms of recall. Also, Gronhaug et al. (1991), as well as Wichmann and Sharpe (2002), defended that the use of colors in advertising is positively correlated with its posterior recognition. However, an opposite stream of research suggests that non-colored ads are more recalled more than colored ads (e.g. Donthu et al., 1993). Such reflects that, besides being scarce, the existing research on the effects of color on advertising memory is often contradictory, being crucial to conduct additional research so that a scientific consensus can be reached.

One other advertising effectiveness metric often present in Marketing literature is the attitude toward the ad (Aad). The understanding of this metric is crucial to distinguish which characteristics of an advertisement lead to more positive evaluations and attitudes in relation to the ad. In parallel to advertising memory, the existing literature linking advertisement color with the attitude toward the ad is still scarce. Gorn et al. (1997) have noticed that colored advertising (vs. non-colored advertising) increased positive attitudes toward the ad. Also,

Lichtlé (2007) depicted that the hue and saturation of an advertisement's dominant color influences the attitude toward that advertisement.

In real-life settings, colors are often presented in combination rather than individually, being crucial to understand advertising effectiveness differences across color schemes. However, literature does not yet link the effects of color combinations (rather than individual color effect or colored vs. non-colored effect comparisons) on advertising memory and attitude toward the ad. Complementary color schemes are color combinations constituted by two colors that are located oppositely to one another on the color wheel. When a color is placed next to its complement, a strong contrast is created, resulting in a very easily noticeable and eye-catching visual composition (Chevreul, 1855). On the other hand, analogous color schemes are color combinations constituted by a set of colors that are close to one another on the color wheel, creating a harmonious color scheme with very similar hues, eliciting less visual attention. Although these effects are known from color theory (e.g. Chevreul, 1855), its potential impacts on advertising have not been investigated yet. In this research, it is therefore explored how the presence of these color schemes in advertising influences the attitude toward as well as the memory for the ad.

LITERATURE REVIEW

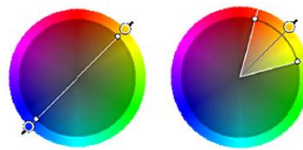
Complementary and Analogous Color Schemes

To understand the concepts of analogous and complementary color schemes, it is crucial to first understand the definition of color wheel and hue. Color wheel is a term used for describing a circular diagram of hues. As Elliot et al. (2015, p. 8) have depicted in their book "Handbook of Color Psychology", hue is an "attribute of a visual perception according to which an area appears to be similar to one of the colors red, yellow, green, and blue, or to a combination of adjacent pairs of these colors". In other words, the hue of a color is defined by the position it occupies around a hue circle (color wheel). Complementary colors are often

defined in literature as two colors located oppositely to one another on the color wheel (e.g. Evans, 1974). However, such definition is ambiguous since there are different definitions for what colors constitute the color wheel, implying that complementary color sets vary across color wheels, depending on the respective color models. Examples of these diverse color wheels are the RYB (red-yellow-blue) color model, the RGB (red-green-blue) color model, and the CMYK (cyan-magenta-yellow-black) color model. In this research, we will only consider the RGB color wheel, since it is the standard color model for color display in electronic screens. Examples of complementary colors in the RGB color model are the yellow and blue and the red and green combinations (*Figure 1*).

Figure 1. Color Schemes Geometric Relations in RGB Color Wheel (Westland et al., 2007, p. 12)

From left to right: Complementary Color scheme and Analogous Color scheme.



Other definition for complementary colors is that these consist of pairs of colors which result in a grey or neutral color when mixed. This mixture can be through either an additive (starting with the absence of light) or subtractive (starting with white light) process (MacAdam, 1938). Besides the above-mentioned approaches to complementary color schemes, there is also the concept of after-image: when a certain color is stared at and then removed from sight, its complementary color will be observed after exposure (Westland et al., 2007). While, when mixed, complementary colors produce a neutral color, Chevreul (1855) has noticed that, when placed side by side, each individual color seems as dissimilar as possible in relation to the other, creating the highest contrast possible between the two, and making each other stand out more to the viewer.

Contrary to complementary colors, analogous color combinations present the least contrast between each other. An analogous group of colors is constituted by a set of adjacent colors which hues are located immediately next to one another on the color wheel (Bleicher, 2011) (*Figure 1*). Commonly, there is one color that functions as the dominant, while the others serve to accent and enhance the overall analogous combination (Mollica, 2013). These schemes often resemble the color schemes found in natural environments, such as blue, blue-green and green often found in green spaces contrasting the blue sky or the different hues that the color of leaves present during Autumn, turning from yellow, to orange and red. Since analogous color schemes are composed by hues very close to each other on the color wheel, when these colors are placed side by side, each individual color takes on the hue of the color next to it, appearing to be very similar between each other, and creating a harmonious combination (Chevreul, 1855).

Color and Advertising Effectiveness

The existing literature on the effects of color is dispersed throughout the most diverse scientific fields - from physics to psychology, sociology, and marketing (Panigyrakis et al., 2015). Such makes it difficult for advertisers to incorporate all the current knowledge onto concrete advertising insights (Panigyrakis et al., 2015). According to the Color-in-Context theory (Elliot & Maier, 2007), the effect of color on thought, emotion, and behavior depends upon the context it is presented. This implies that the effect of color may differ across media vehicles used for advertising exposure (e.g. print advertising, online banner advertising, mobile advertising, etc.). Besides, according to Color-in-Context theory, the effect of color is formed in an integrated manner, meaning that findings on other fields often cannot be directly transposed to the marketing context. Furthermore, the study of the influence of color in marketing is still at a very initial stage (Labrecque et al., 2013), being of major importance to conduct additional research on this subject.

Regarding advertising specifically, the existing literature on the effects of color can be divided into three main subcategories (Panigyrakis et al., 2015): influence of color on attention, influence of color on emotion, and influence of color on memory. Regarding the effects of advertising color on attention, Lohse and Rosen (2001) have observed that, in the context of print advertising, colored advertisements presented higher attention scores than non-colored advertisements. Within the same context, Fernandez and Rosen (2000) have found that colored ads (vs. non-colored ads) were more attention-getting, resulting in higher probability of being included in consumers' consideration set. In respect to the influence of ad color on emotion, Lohse and Rosen (2001) noticed that, in the context of print advertising, colored advertisements induced increased liking and a more favorable attitude toward the ad than non-colored advertisements. On another research, led by Gorn et al. (1997) within the same context, it was observed that advertising containing color with high levels of brightness provoked increased relaxation and a more positive attitude toward the ad. Furthermore, advertising containing highly saturated color produced more positive emotions respecting the ad. It is also concluded in Gorn et al. (1997) research that emotion has a mediating effect on the influence of advertising color on subsequent attitudes towards the ad. Valdez and Mehrabian (1994) have observed that colors belonging to the blue hued spectrum were more positively evaluated than all others. In addition, Lichtlé (2007) demonstrated that the dominant color of advertisements influenced the emotions and the attitude toward the ad: the hue and saturation of an advertisement's dominant color impacted the level of pleasure induced by the ad visualization, increasing positive attitudes toward the ad. Regarding the effects of color on memory, it is predominantly agreed on literature that color can influence visual memory (Wichmann & Sharpe, 2002). However, the existing literature is limited and sometimes contradictory. In the context of outdoor advertising, Donthu et al. (1993) found that non-colored advertising had higher levels of unaided recall of ad attributes when compared to colored advertising. On the other side of

literature, in the print advertising setting, Meyers-Levy and Peracchio (1995) depicted that colored advertising (vs. non-colored advertising) resulted in higher unaided recall under low cognitive resources demand (low-involvement decision making), being the opposite true for high cognitive resources demand situations (high-involvement decision making). Also, Gronhaug et al. (1991) remarked that a higher number of colors used on advertising had a positive influence in the ability to recognize the advertisement after ad exposure. Supporting these findings, in a more recent research, Wichmann and Sharpe (2002) demonstrated that the recognition memory for colored images was superior to the recognition memory for non-colored images.

In the present research, it will be studied the above-mentioned subcategories that relate color with memory and emotion, by assessing both unaided recall and recognition of advertisement attributes, as well as the attitude toward the ad (Aad). Advertisement recall is a memory-based measure of ad effectiveness that assesses explicit memory of advertising. By explicit memory, it is understood to be the ability of individuals to consciously retrieve information associated with an ad exposure that took place at a previous point in time (Shapiro & Krishnan, 2001). Advertisement recall may be measured on an unaided or aided basis, being the unaided recall (or free recall) assessed by the ability of an individual to recall advertising information without the provision of any cues, while the aided recall assesses the ability of an individual to recall advertising information when provided with some retrieval cues that help remembering the previous advertising visual exposure. Other measure that is often used to assess explicit memory for advertising is recognition: it is the ability of an individual to identify information that was exposed previously on the advertisement when presented with several options (for instance, when presented with ten brand names, the individual is asked to identify the one that was advertised before). According to Lutz (1989, p.49) in his article “An Empirical Examination of the Structural Antecedents of Attitude toward the Ad in an Advertising

Pretesting Context”, attitude toward the ad (Aad) is other advertising effectiveness measure that assesses “the predisposition to respond in a favorable or unfavorable manner to a particular advertising stimulus”. Following earlier investigations on the effects of color on memory and emotion, this research will use both free recall, recognition, and attitude toward the ad (Aad) as reference measures for assessing advertisement effectiveness (Moore et al., 2005).

Product Involvement and Advertising Effectiveness

According to Marketing theory, products can be categorized as high-involvement or low-involvement products according to aspects such as its durability, price and the level of associated risk tangled with the buying process (Kotler et al., 2008). High-involvement products are characterized by having a high price, involving high risk of purchase, and are acquired on an unregular basis. The high-involvement purchase decision making is often complex and lengthy as it involves searching and processing information to make the best decision possible, given the associated risk (Kotler et al., 2008). Examples of these products are cars, televisions and clothing. Inversely, low-involvement products are characterized by having a low price, involving low risk of purchase, and are acquired on a regular basis. Low-involvement purchases are often part of the quotidian and entangle very low effort and involvement in the buying decision making process, once it involves few risks and the choice has little impact on the individual’s wellbeing (Kotler et al., 2008). Examples of these products are breakfast cereals, laundry detergent or coffee. The low-involvement purchase decision making process is therefore often very brief. According to the Elaboration-Likelihood Model (Petty & Cacioppo, 1986) and the General Resource Principle (Anand & Sternthal, 1989), consumers processing involvement moderates the influence of color on advertising. In low-involvement settings, since the purchase decision is undertaken very quickly with low processing motivation, emotional resources are used in detriment of cognitive resources. Such scenario leads consumers to base their low-involvement decisions on heuristics such as the perceived pleasantness of an

advertisement, and this perceived pleasantness can be greatly influenced by advertisement color (Lichtlé, 2007). Gopikrishna and Kumar (2015) have also observed that about 90% of fast evaluations of products are based on color only. Alongside the previously mentioned influence of involvement in advertisement color effects, Meyers-Levy and Peracchio (1995) have noticed that, under low-involvement settings, the recall and product attitude for colored advertisements was superior to non-colored advertisements, being the opposite true under high-involvement settings. Therefore, since advertising color has different effects depending on the involvement level, and previous studies have suggested the increased importance of color on low-involvement decision making, in this research, only low-involvement settings will be considered. This way, we can better isolate the effect of color on advertising effectiveness, avoiding the possible influence of involvement on the results.

Research Hypotheses

As mentioned above, the existing studies on the effects of color on advertising effectiveness are sometimes contradictory. Such may derive from the Color-in-Context Theory observed by Elliot and Maier (2007) which states that the effects of color vary with the context it is inserted in. This theory implies that the same color stimulus present in an advertisement may have dissimilar influences depending on contextual factors such as the media vehicle used to present it. This explains why, for instance, in the context of outdoor advertising, Donthu et al. (1993) suggested that non-colored ads were better recalled than colored ads, while, in the context of print advertising, Gronhaug et al. (1991) have observed that colored ads were better recalled than non-colored ads. Such means that it is imperative to conduct additional research in new contexts so that the effects of color on advertising effectiveness are entirely uncovered. The present research is therefore focusing in a context that is relatively new to the existing literature: mobile advertising. One other factor that may explain the contradictory findings on the effect of color on advertising effectiveness is that most of existing studies did not consider

the moderating influence of involvement. Meyers-Levy and Peracchio (1995) depicted that, under high-involvement settings, non-colored advertisements were better recalled and resulted in more positive attitudes than colored advertisements, being the opposite true under low-involvement settings. However, to our knowledge, there is no further research on the effects of color on ad effectiveness that takes involvement into account. Therefore, in the present research, involvement will be controlled by limiting the employed advertisements to low-involvement settings, where it is expected to observe increased ad memory and attitudes for colored (vs. non-colored) ads. Furthermore, since past studies have only tested ad effectiveness for colored vs. non-colored advertisements, not exploring advertising color effects on ad memory and attitude across different color schemes, this research aims to answer the following research questions:

RQ1: How does the presence of complementary colors vs. analogous colors on advertising influences the ad recall and ad recognition in the context of mobile advertising under low-involvement settings;

RQ2: How does the presence of complementary colors vs. analogous colors on advertising influences the attitude toward the ad in the context of mobile advertising under low-involvement settings.

Given Chevreul (1855) findings that complementary colors elicit greater visual attention when comparing to analogous colors and Meyers-Levy and Peracchio (1995) findings that, under low-involvement settings, colored advertising is more memorized than non-colored advertising, we can therefore hypothesize:

H1: The presence of complementary colors in advertising increases the unaided ad recall under low-involvement settings (when comparing to control and analogous colors).

H2: The presence of analogous colors in advertising increases the unaided ad recall under low-involvement settings (when comparing to control).

H3: The presence of complementary colors in advertising increases the ad recognition under low-involvement settings (when comparing to control and analogous colors).

H4: The presence of analogous colors in advertising increases the ad recognition under low-involvement settings (when comparing to control).

The second research question results from previous studies noticing that advertising color can positively influence the attitude toward the ad (A_{ad}) (Gorn et al., 1997; Lichtlé, 2007; Meyers-Levy & Peracchio, 1995). These studies suggest that colored (vs. non-colored) advertising increases positive attitudes toward the ad. However, research is lacking attitudinal differences across different color schemes. Even though there is no research on the attitude difference between analogous and complementary colored advertising, Valdez and Mehrabian (1994) have observed that colors belonging to the blue hue spectrum (blue analogous) were individually evaluated as more pleasant than all others. We therefore expect colored advertising (vs. non-colored advertising) to have more favorable attitudes toward the ad and blue hue analogous colored advertising to induce a more positive attitude toward the ad when comparing to complementary colored advertising. Thus, we hypothesize:

H5: The presence of complementary colors in advertising increases positive attitudes toward the ad under low-involvement settings (when comparing to control).

H6: The presence of analogous colors in advertising increases positive attitudes toward the ad under low-involvement settings (when comparing to control and complementary colors).

METHODOLOGY

The present experimental research is composed by two separate studies relating to the effects of complementary and analogous color schemes on advertising effectiveness. The first study focuses on the influence of complementary and analogous colors on the unaided recall

and recognition of advertising and it aims to test the first, second, third, and forth hypotheses. The second study focuses on the influence of complementary and analogous colors on the attitude toward the ad and it aims to test the fifth and sixth hypotheses. Data was analyzed with SPSS 24 for both studies. In all statistical analyses, a significance level of .05 was used.

Study 1

The first study has as dependent variables the unaided ad recall and recognition. Data for this study was gathered via a Qualtrics developed survey that was distributed to 120 participants under controlled experimental conditions (responses undertook on mobile devices screens, assured visualization of all advertising images, and same ambient lighting). Each participant was randomly allocated to one of the 3 independent experimental conditions (for each group n=40): (1) survey with advertising containing complementary colors (*Figure 2*); (2) survey with advertising containing analogous colors (*Figure 3*); (3) survey with advertising containing a grey scale color (control group) (*Figure 4*). Initial demographic questions were asked to participants to determine their age, gender and nationality. All participants were Portuguese, aged between 18 and 25 years old, and there was an even gender balance in each group. Such homogeneous sample was intended to avoid possible external factors deviating the effects of color on memory, such as age, and different color connotations and preferences between cultures (Madden et al., 2000). In order to detect colorblindness, participants were then asked to type the numbers they saw in 8 Ishihara plates (Waggoner, n.d.). Participants that answered incorrectly to more than one color plate were considered colorblind, being immediately redirected to the end of the survey and excluded from the analysis. Participants that passed the colorblindness test were exposed to a series of 8 advertisements of low-involvement products (yoghurt, detergent, sparkling water, popcorn, potato chips, breakfast cereals, toothpaste, and chocolate). The advertising visualization order was randomized to avoid recency effects and the brand names used were fictitious to avoid the possible interference

of previous experiences on the ad memory performance. Each group of participants was exposed to the same advertisements, only varying the ad color. The complementary and analogous color schemes used were chosen based on the RGB color model, using an online color calculator for this purpose (<https://www.sessions.edu/color-calculator>). The group with complementary colored advertising was exposed to four advertisements colored in yellow and blue (R:255 G:251 B:40; R:40 G:44 B:255) and four advertisements colored in rose and green (R:255 G:145 B:202; R:145 G:255 B:198). The group with analogous colored advertising was exposed to four advertisements colored in blue analogous (R:40 G:44 B:255; R:40 G:151 B:255) and four advertisements colored in orange analogous (R:255 G:181 B:96; R:250 G:255 B:96) (*Figure 5*). Control group was exposed to the same eight advertisements with a grey scale applied. All the advertisements were created using Photoshop software.

Figure 2. Complementary colored advertising used for study on ad memory

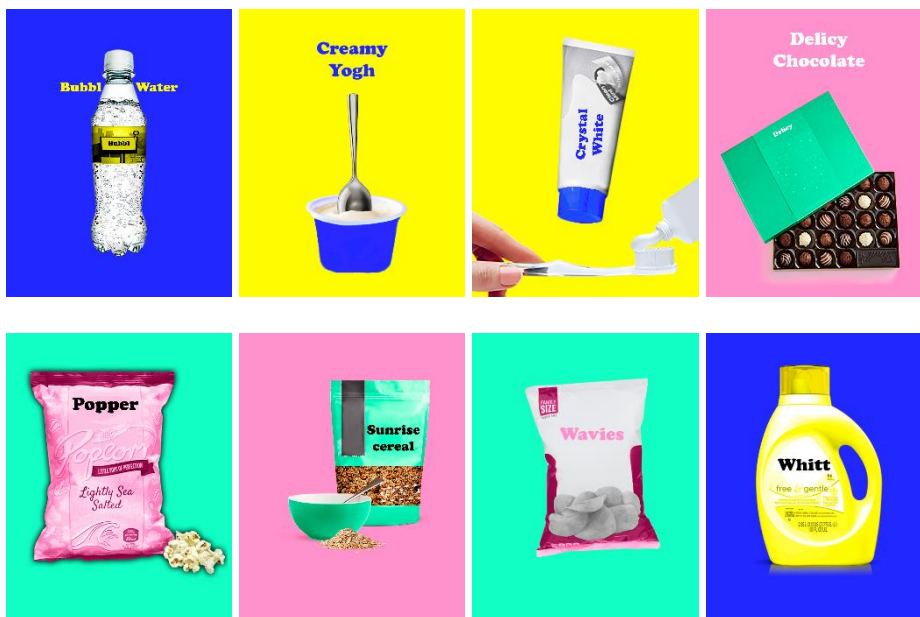


Figure 3. Analogous colored advertising used for study on ad memory

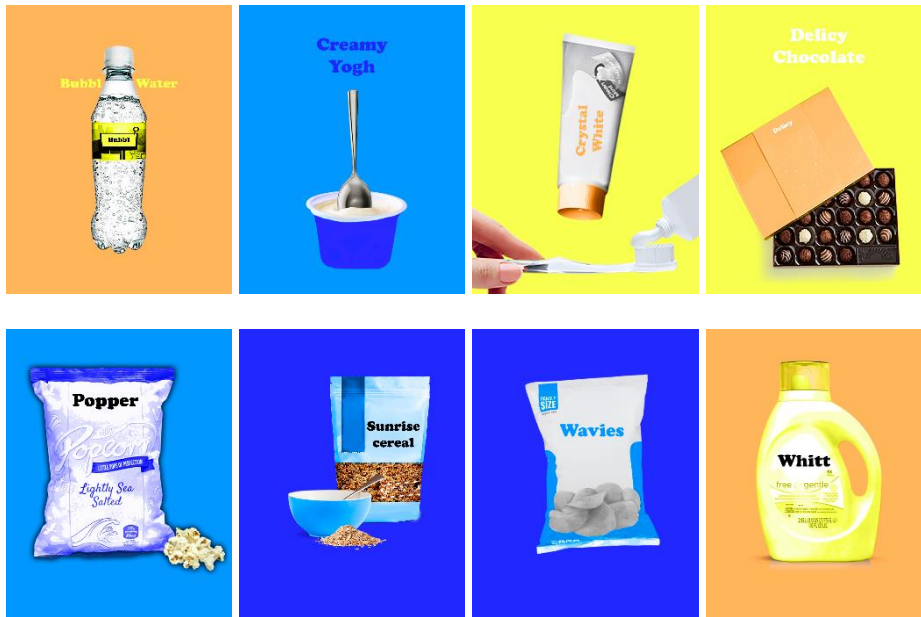


Figure 4. Grey-scaled advertising used for study on ad memory



Figure 5. Color schemes used for study on ad memory

From left to right: rose and green complementary scheme, yellow and blue complementary scheme, orange analogous, and blue analogous color schemes.



The exposure time of each advertisement was of 0.5 seconds. After the advertising visualization, participants were asked to engage in a distractor exercise not related with the

study (they were asked to find the words hidden in a picture). This exercise took approximately 2 minutes to complete, giving a time interval between ad exposure and recall and recognition questions. When the distractor exercise was complete, participants were asked to fill a blank text box with all the brands and product types they recalled seeing during the advertising exposure (unaided ad recall). Then, they were requested to recognize the brand names they remembered visualizing before (recognition). Besides the eight brand names, three false options were also provided to guarantee more truthful answers. After such, the same question appeared for product types, asking participants to recognize the ones they remembered. Three false options were also provided. Regarding the scoring of the questionnaire for the dependent variables, the unaided recall answers were scored as 1 for correctly recalling a brand name, 0.5 for correctly recalling a product type, and 0 if neither (Moore et al., 2005). This means that each participant could score in total 12 points in unaided recall ($0.5 \times 8 + 1 \times 8$). The recognition responses were scored as 1 for correctly recognizing a brand name and 1 for correctly recognizing a product type (Moore et al., 2005). Such means that each participant could score in total 16 points in recognition ($1 \times 8 + 1 \times 8$).

Study 2

A second study was conducted with the dependent variable attitude toward the ad (Aad). Data for this study was gathered via a Qualtrics developed survey that was distributed to 60 participants (n=60) under controlled experimental conditions (responses undertook on mobile devices screens, assured visualization of all advertising images, and same ambient lighting). For this study, three fictitious advertisements of a low-involvement product (coffee) were created using Photoshop software. All the three advertisements were identical, only varying the employed color: one advertisement colored in complementary colors (blue and yellow); one advertisement colored in analogous colors (blue analogous); one control advertisement with a

grey-scale applied (*Figure 6*). For simplification purposes, in this study, only one of each group's color schemes previously used in Study 1 was considered (*Figure 7*).

Figure 6. Advertising used for study on attitude toward the ad

From left to right: complementary, analogous, and grey-scaled colored advertising.



Figure 7. Color schemes used for study on attitude toward the ad

From left to right, complementary and analogous color schemes.



Each participant was presented with the three advertisements and asked to answer the same group of questions for each one of the advertising images. These questions were aimed to measure the attitude toward the ad (Aad) through a six-item, seven-point scale commonly used in previous research to quantify the attitude toward the ad (De Pelsmacker, Geuens & Anckaert, 2002) (*Table 1*). As such, each item was scored on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree). The total scoring for the attitude towards each ad would then be calculated as the sum of all the scores, with the exception of the fifth item that was scored reversely (e.g. “strongly agree” would translate in 1 point scoring for this item).

Table 1. Questions used to measure participants' attitudes toward the ad

1.	I got a positive impression.
2.	I found it really something for me.
3.	I found it interesting.
4.	I found it credible.
5.	I found it exaggerated (r).
6.	I found it attractive.

Demographic questions were then asked to respondents to determine their age, gender and nationality. All participants were Portuguese, aged between 18 and 25 years old, and there was an even gender balance in each group, to avoid possible external factors deviating the effects of color on memory (e.g. age, differing color meanings and preferences across cultures). Finally, to detect colorblind respondents, 8 Ishihara color plates were presented, and participants were asked to type the numbers they saw on each plate.

RESULTS

Study 1

To arrange the collected data for statistical analysis, incorrect answers to more than one of the eight Ishihara color plates were excluded from the analysis. The unaided ad recall and recognition answers were quantified numerically according to the previously mentioned scoring (Moore et al., 2005). To test if there was a statistically significant difference between the unaided ad recall scores of grey-scaled, complementary, and analogous colored groups, a one-way analysis of variance (ANOVA) was conducted. The analysis of variance (ANOVA) with the unaided recall score as the dependent variable presented a statistically significant difference of advertising color effect between the three experimental conditions, $F(2,117) = 5.208$, $p < 0.05$ (*Appendix 1*). Thus, we reject the null hypothesis that all advertising color schemes produce the same unaided recall scores. To test for statistically significant differences between subgroups, a post-hoc Tukey HSD test was conducted (*Appendix 2*). The first hypothesis (H1) examined if complementary color schemes, by eliciting more visual attention, would be easier to recall and would in turn present higher unaided recall scores when comparing to control treatment and analogous colored advertising. The results for this test conclude that complementary colored advertising (vs. control treatment) increases the unaided recall scores ($p = 0.010$, mean difference = 1.025). It also ascertains that complementary colored advertising

significantly increases the unaided recall scores when comparing to analogous colored advertising ($p = 0.030$, mean difference = 0.888). Thus, the first hypothesis (H1) is supported. The second hypothesis (H2) examined if analogous colored advertising presented higher unaided recall scores comparing to non-colored advertising. The results for this test ascertain that analogous colored advertising (vs. control) did not significantly increase the unaided recall scores ($p > 0.05$). Therefore, the second hypothesis (H2) is not supported. A one-way analysis of variance (ANOVA) was also conducted with the recognition score as the dependent variable to determine if there were statistically significant differences between advertising color schemes. This test presented a statistically significant difference in advertising color effect between the three experimental conditions, $F(2,117) = 4.398$, $p < 0.05$ (*Appendix 3*). Thus, we reject the null hypothesis that all advertising color schemes produce the same recognition scores. The third hypothesis (H3) examined whether complementary color schemes, by eliciting more visual attention, would be easier to recognize after exposure and would in turn present higher recognition scores when comparing to control treatment and analogous colored advertising. A post-hoc Tukey HSD analysis was conducted (*Appendix 4*), revealing that complementary colored advertising (vs. control treatment) increased recognition scores ($p = 0.022$, mean difference = 1.650). This test also revealed that complementary colored advertising increased recognition scores when comparing to analogous colored advertising ($p = 0.045$, mean difference = 1.475). Therefore, the third hypothesis (H3) is supported. The fourth hypothesis (H4) examined whether analogous colored advertising presented higher recognition scores when comparing to non-colored advertising. The post-hoc Tukey HSD comparison revealed that analogous colored advertising did not significantly increase recognition scores when compared to control group ($p > 0.05$). Therefore, the fourth hypothesis (H4) is not supported. Recall and recognition mean scores for each advertising color can be found on *Table 2*.

Table 2. Mean Recall and Recognition Scores Across Advertising Colors

Scale	Experimental Condition, <i>M</i> (<i>SD</i>)		
	Control Group	Analogous Color	Complementary Color
Unaided Recall	2.14 (1.26)	2.28 (1.71)	3.16 (1.62)
Recognition	8.43 (2.49)	8.60 (3.02)	10.08 (2.66)

Study 2

Similar to study 1, to prepare the collected data for statistical analysis, respondents that incorrectly answered to more than one of the eight Ishihara color plates were excluded from the analysis. The objectives of this study were to confirm the theoretical assumption that colored advertising (independent of the chosen color schemes) lead to a better attitude toward the ad (Aad) when comparing to non-colored advertising, as well as to explore attitudinal differences across advertising color schemes. To test whether there were statistically significant differences on the attitude toward the ad (Aad) between the three advertisement color schemes, a single-factor repeated measures analysis of variance (rANOVA) was conducted (*Appendix 5*). This test presented a statistically significant difference of attitude toward the ad between the three advertising color schemes, $F(2, 118) = 31.730, p < 0.05$. Thus, we reject the null hypothesis that all color schemes produce the same level of attitude toward the ad. The fifth hypothesis (H5) aimed to confirm if complementary colored advertising had higher attitude toward the ad scores than non-colored advertising. A post-hoc Bonferroni comparison (*Appendix 6*) showed that complementary colored advertising (vs. control treatment) significantly increased the attitude toward the ad ($p = 0.000$, mean difference = 4.550). The fifth hypothesis (H5) is therefore supported. The sixth hypothesis (H6) examined if analogous colored advertising (vs. control treatment and complementary colored advertising) positively influenced the attitude toward the ad. The post-hoc Bonferroni comparison exhibited enough statistical evidence that

analogous colored advertising (vs. control treatment) increased the attitude toward the ad scores ($p = 0.000$, mean difference = 8.733). It also presented that analogous colored advertising significantly increased the attitude toward the ad when compared to complementary colored advertising ($p = 0.001$, mean difference = 4.183). Thus, the sixth hypothesis (H6) is also supported. The means for the attitude toward the ad scores across advertisement color schemes can be found in *Table 3*.

Table 3. Mean Attitude Toward the Ad Scores Across Advertising Colors

Scale	Experimental Condition, $M (SD)$		
	Control Group	Complementary Color	Analogous Color
Attitude Toward the Ad	18.32 (6.27)	22.87 (7.22)	27.05 (6.87)

DISCUSSION

General Discussion

The present research contributes to the existing literature on the influence of color in advertising effectiveness by exploring the effects of complementary and analogous color schemes on ad memory and attitude, under low-involvement settings and in the context of mobile advertising. Previous studies have shown contradictory effects of the presence of color on advertising memory and did not distinguish ad memory and attitude differences between specific color schemes. The results from the first study reflect that the presence of complementary colors in advertising positively influences ad memory (ad recall and recognition), demonstrating to induce higher memory for the advertisement when compared to both analogous colored and non-colored advertising. Such may derive from the fact that complementary color schemes make each individual color stand out more (Chevreul, 1855), eliciting more visual attention to the beholder and thus being more noticeable and easier to

memorize. In turn, analogous colored advertising did not present to significantly influence the memory for the ad. Such shows that colored vs. non-colored previous studies are not sufficient, being important to study the influence of specific colors in advertising. The results from the second study show that both analogous and complementary color schemes significantly contribute to a more favorable attitude toward the ad (A_{ad}). These findings are in accordance with previous studies stating that the presence of color on advertising leads to more positive attitudes toward the ad (Gorn et al., 1997; Lichtlé, 2007; Meyers-Levy & Peracchio, 1995). While confirming previous studies, the present research also complements the existing literature by investigating attitudinal differences across different color schemes: blue analogous colored advertising presented more positive attitudes toward the ad than blue and yellow (complementary) colored advertising. The fact that analogous colored advertising elicited more positive attitudes toward the ad than complementary colored advertising may derive from the fact that analogous color schemes resemble the color schemes observed in natural sceneries (e.g. the blue analogous scheme created by the blue-green sea against the blue sky landscape), hence being more pleasing to the eye and eliciting more positive attitudes by the viewer (Wolfrom, 1992).

It was therefore possible to conclude with this research that different color schemes have different effects on advertising. In the context of mobile advertising, under low-involvement settings, complementary color schemes revealed to elicit greater advertisement memory, while analogous color schemes revealed to elicit more positive attitudes toward the ad. Such findings have implications for marketers and advertisers when choosing the best color to use on advertising in consonance with their goals. For each advertisement, they can then adjust their color choices according with its specific purpose, resulting in more effective marketing decisions.

Limitations and Directions for Future Research

The present research contains limitations that ought to be considered when analyzing the experimental results. Even though the advertisements created for the experimental studies attempted to maintain a high degree of realism, they were still fictitious. This is a limitation since the advertisements did not have the same complexity and quality as they would in real world settings. Despite all studies have been conducted under controlled experimental conditions (e.g. responses undertook on mobile devices screens, assured visualization of all advertising images, and same ambient lighting), the resolutions of participants' mobile screens could vary, which could affect the perception of color. Other limitation is the fact that, for simplification purposes, on the second experimental study, only one color scheme was used for each condition (yellow and blue for complementary colored condition and blue analogous for analogous colored condition). Such did not allow to ascertain if the same results would apply to other color schemes used in the first study, such as orange analogous scheme and green and rose complementary scheme. Regarding the colorblindness detection tool used to validate the participants responses, it was only used a short version of the Ishihara test. This means that participants with a certain degree of colorblindness could have passed the test, thus deviating the experimental results. There are various opportunities for future research. As an example, it could be interesting to conduct a study using real advertisements in real world settings, such as intermittently presenting real advertisements while participants scroll through their mobile phones' applications. Another aspect worth exploring is related with the fact that only low-involvement settings were considered in this research. In future studies, high-involvement settings could be explored, to understand if the effects of color on advertising are consistent or opposite to the ones observed in low-involvement settings. In addition, even though the selection of low-involvement products was carefully performed (e.g. similar price and risk of purchase across advertised products), it would be value-adding to increase the number of products to eliminate the influence of possible deviating factors. It would also be important to

conduct this research on different contexts besides mobile advertising, such as outdoor advertising. Since all participants were Portuguese, and between 18 and 25 years old, it would be interesting to conduct this experiment on other cultures and age groups. Also, new studies using other complementary and analogous color schemes could be conducted. Finally, future research could investigate the effects of analogous and complementary colors on other advertising effectiveness measures such as purchase intention or attitude toward the brand.

CONCLUSION

The present research findings allow us to conclude that, under low-involvement settings, the presence of complementary colors in mobile advertising can greatly influence the ability to recall and recognize the advertisement after exposure. It is also inferred that the presence of analogous colors in advertising does not influence the memory for the advertisement in this context. Other significant remark of this research is that the presence of analogous colors as well as the presence of complementary colors in mobile advertising both positively influence the attitude toward the advertisement, being the analogous color scheme the one that induces the greatest positive attitude toward the ad under low-involvement settings.

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APPENDICES

Appendix 1. Unaided Recall Score ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.763	2	12.381	5.208	0.007
Within Groups	278.162	117	2.377		
Total	302.925	119			

Appendix 2. Unaided Recall Score ANOVA: Tukey HSD Post-Hoc Analysis

(I)	(J)	(I-J)			
Advertising	Advertising	Mean Difference*	Sig.	Lower	Upper
Color	Color			Bound	Bound
Complementary	Control	1.025	0.010	0.2065	1.8435
	Analogous	0.888	0.030	0.0690	1.7060
Analogous	Control	0.138	0.916	-0.6810	0.9560
	Complementary	-0.888	0.030	-1.7060	-0.0690

*Mean difference significant at 0.05.

Appendix 3. Recognition Score ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	65.717	2	32.858	4.398	0.014
Within Groups	874.150	117	7.471		
Total	939.867	119			

Appendix 4. Recognition Score ANOVA: Tukey HSD Post-Hoc Analysis

(I)	(J)	(I-J)			
Advertising	Advertising	Mean	Sig.	Lower	Upper
Color	Color	Difference*		Bound	Bound
Complementary	Control	1.650	0.022	0.1991	3.1009
	Analogous	1.4750	0.045	0.0241	2.9259
Analogous	Control	0.1750	0.956	-1.2759	1.6259
	Complementary	-1.4750	0.045	-2.9259	-0.0241

*Mean difference significant at 0.05.

Appendix 5. Attitude Toward the Ad rANOVA: Test of Within-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Advertising Color	2289.48	2	1144.74	31.73	0.00*
Error (Ad. Color)	4257.19	118	36.08		

*Sphericity Assumed by Mauchly test

Appendix 6. Attitude toward the ad rANOVA: Post-Hoc Bonferroni Analysis

(I)	(J)	(I-J)			
Advertising	Advertising	Mean	Sig.	Lower	Upper
Color	Color	Difference		Bound	Bound
Complementary	Control	4.550	0.000	2.009	7.091
	Analogous	- 4.183	0.001	-6.865	-1.502
Analogous	Control	8.733	0.000	5.859	11.607
	Complementary	4.183	0.001	1.502	6.865

Appendix 7. Study 1 Questionnaire

PART 1:

Age:

Nationality:

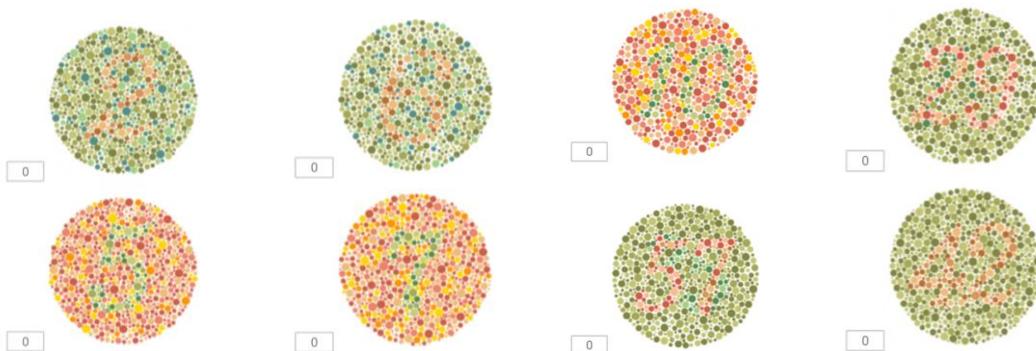
Gender:

Male

Female

PART 2:

Please write the numbers you see on each plate.



PART 3:

When you click the "next" button, you will be presented with a series of advertising. You will not have to press any keys during this time. Please pay attention.

PART 4:

Now, please pay attention to the following image.



Can you find the 6 words hidden in this image?
Please write below the words you have found.

PART 5:

Please write below all the product types you remember seeing previously on the ads:

Please write below all the brand names you remember seeing previously on the ads:

PART 6:

Please indicate below the brand names you remember seeing previously on the ads:

Best Toast
Delicy
Popper
Wavies
Creamy Yogh
Sunrise
Crystal White
Whitt
Supercare
Sprk
Bubbl

Please indicate below the product types you remember seeing previously on the ads:

Bread
Chocolate
Popcorn
Chips
Yoghurt
Cereals
Toothpaste
Detergent
Hand Wash
Beer
Water

Appendix 8. Study 2 Questionnaire

PART 1:

While looking at this advertisement...



	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I got a positive impression.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it really something for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it credible .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it exaggerated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it attractive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

While looking at this advertisement...



	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I got a positive impression.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it really something for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it credible .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it exaggerated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it attractive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

While looking at this advertisement...



	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I got a positive impression.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it really something for me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it credible .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it exaggerated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it attractive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

PART 2:

Age:

Nationality:

Gender:

Male

Female

PART 3:

Please write all the numbers you see below (left to right and top to down).

